Calibration of Mariner 6/7 Infrared Spectrometers. P.B. Forney[1] and L.E. Kirkland[2]. [1]Lockheed Martin, Palo Alto, CA; [2]Lunar and Planetary Institute, Houston, TX.

Introduction: The Mars Mariner 6/7 Infrared Spectrometers (IRS) returned reflection/emission spectra covering 1.9-14.4μm, and they remain a valuable source of information covering this spectral region. However, use of the spectra has been limited by the scarcity of calibration information for the instruments. The most intractable calibration issue for IRS has been the lack of a wavelength calibration, and as a result, each spectrum must be calibrated by hand. We detail here the unpublished wavelength calibration determined by the original IRS team that may resolve this problem.

Filter transmission and resolution: The only published data [1] for the transmission and resolution of the IRS circular variable interference filters (CVIF) used data supplied by the manufacturer. However, these were later remeasured at UC Berkeley with a spectrophotometer for the CVIFs alone, and these data are shown in Table 1.

Wavelength calibration: The only published wavelength calibration [2] also used data supplied by the manufacturer. However, a later, unpublished calibration made in 1972 used spectra measured preflight, spectra returned from Mars, and spectra measured by the lab instrument, Flight C. We report here only the calibration for the IRS-7 spectra for the shortest wavelength section, 1.882-3.678μm. To make the calibration, a subset of spectra were plotted, and the locations of the band centers listed in Table 2 were marked. The spectra were then rescaled so that the center of the first fiduciary spike was set to 0 and the center of the second spike was set to 100. These points were fit with a second order polynomial. This fit is then applied to each rescaled spectrum beginning at the midpoint of its first fiduciary spike and continuing through the midpoint of the second spike.

Results: Figure 1 shows some representative IRS-7 spectra plotted with this wavelength calibration. The result is that for most of the spectra, any given band position ranges within 0.02μm. However, two problems remain. First, some of the band centers chosen for the calibration may be incorrect, so that they are consistently off for all the spectra. Second, some of the spectra do not have band centers that fall where they should (Fig.2). Most of these spectra occur just after a platform slew, which may have temporarily destabilized the power supply frequency, and thus affected the rate at which the filter disk turned, and so corrupted the calibration. Nonetheless, this calibration allows the calculation of wavelength for most of the spectra with a single formula, and it thus represents a vast improvement over the previous technique which requires a hand calibration for each spectrum.

References: [1] Herr, K.C. *et. al,* (1972) *App. Opt. 11*, 493. [2] Herr and Pimentel, (1970) Data Format Report.

Table 1: CVIF transmission and resolution.

Angle=filter rotation in degrees; λ, μm =wavelength in microns; res=filter resolution in percent (half band width); trans=filter transmission in percent; IRS-C=backup and lab instrument, identical to IRS-6 and 7.								
Angle	IRS-6 λ,μm	IRS-6 res, %	IRS-6 trans	IRS-7 λ, μm	IRS-7 res, %	IRS-7 trans	IRS-C λ, μm	IRS-C res, %	IRS-C trans
Short wavelength CVIF data:									
0	1.880	0.798	40	1.882	0.882	30	1.883	0.850	30
30	2.125	0.884	40	2.141	0.981	39	2.125	0.932	39
60	2.453	0.938	43	2.460	0.976	48	2.454	0.937	50
90	2.803	0.953	47	2.778	1.133	52	2.807	1.033	54
120	3.135	0.878	48	3.105	1.031	55	3.147	1.032	55
150	3.445	0.868	51	3.415	0.929	57	3.451	0.939	56
180	3.715	0.847	52	3.678	1.000	42	3.679	0.883	42
185	3.126	1.063	49	2.985	0.716	37	2.985	0.693	38
210	3.530	0.988	48	3.417	0.929	38	3.475	0.904	38
240	4.069	1.025	49	3.940	0.961	40	4.010	0.898	45
270	4.636	0.983	49	4.484	0.807	42	4.529	0.833	50
300	5.170	0.962	41	5.106	0.742	45	5.049	0.990	52
330	5.670	0.964	33	5.539	0.831	44	5.562	0.801	50
355	6.041	1.003	24	5.997	0.780	48	5.997	0.768	48
Long wavelength CVIF data:									
5	4.00	0.800	36	3.97	0.746	29	3.921	1.067	40
30	5.43	0.906	39	4.50	0.774	31	4.481	0.968	41
60	5.19	0.830	36	5.19	0.768	32	5.165	0.919	41
90	5.86	0.645	37	5.91	0.934	34	5.865	0.903	42
120	6.56	0.695	43	6.64	0.996	37	6.579	0.855	42

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150	7.25	0.899	51	7.27	0.945	47	7.264	0.915	45
175	7.81	0.828	50	7.78	1.105	48	7.788	0.857	46
185	7.41	1.008	56	7.55	0.906	44	7.553	0.967	51
210	8.41	0.925	59	8.45	0.980	47	8.575	0.926	53
240	9.71	0.932	54	9.59	0.921	49	9.789	0.881	52
270	11.10	0.888	50	10.85	0.868	50	11.013	0.903	51
300	12.40	0.818	43	12.15	0.486	42	12.136	0.850	43
330	13.60	0.680	34	13.33	0.746	33	13.246	0.861	32
355	14.51	0.638	30	14.26	0.713	28	14.215	0.995	26

Table 2: Band centers for the shortest wavelength section calibration.

λ, μm	1.96	2.01	2.06	2.69	2.77	3.31	3.29	3.42	3.51	2.99
type	CO_2	CO_2	CO_2	CO_2	CO_2	CH_4	Poly	Poly	Poly	NH_3
For IRS-7, the center of the fiduciary spikes are assigned 1.882 and 3.678μm. Poly=polystyrene										

Arbitrary Intensity

Figure 1: These spectra have the new wavelength calibration. Note that the band centers plot at consistent wavelengths within 0.02μm.

Fiduciary spikes

wavelength, microns

Figure 2: This shows spectra which do not have consistent band centers. For reference, the solid line shows a spectrum whose band centers plot in the same location as the spectra shown above. Both of the dashed spectra were acquired just after a platform slew.